to a near ancestor we need a broader basis of fact than we have at present before we can formulate any law. The recorded cases show that many phenomena are labelled reversions on the flimsiest evidence. Thus the occurrence of a Cyclopean human monster with a median eye has been called a reversion to the sea-squirt, and gout has been called a reversion to the reptilian condition of liver and kidneys. Often there is not the slightest attempt to discriminate between true reversion (*i.e.* the re-expression of latent ancestral characters) and the phenomena of arrested development, or of abnormalities which have been induced from without. Often, too, there has been no scruple in naming or inventing the ancestor to whom the reversion is supposed to occur, although evidence of the pedigree is awanting; and the vicious circle is not unknown of arguing to the supposed ancestor from the supposed reversion, and then justifying the term reversion from its resemblance to the supposed ancestor. Little allowance has been made for coincidence, and the postulate of characters remaining latent for millions of years is made as glibly as if it were just as conceivable as a throw-back to a great-grandfather.

There seems no way out of the theory that characters may lie latent for a generation or for generations, or in other words that certain potentialities or initiatives which form part of the heritage may remain unexpressed for lack of the appropriate liberating stimulus, or for other reasons, or may have their normal expression disguised. But it does not follow that the reappearance of an ancestral character not seen in the parents is necessarily due to the reassertion of latent elements in the inheritance. It may be a case of ordinary regression; it may be a case of arrested development; it may be an extreme variation whose resemblance to an ancestral characteristic is a coincidence; it may be an individually acquired modification, reproduced apart from inheritance, by a recurrence of suitable external conditions, and so on. What are called reversions are probably in many cases misinterpretations.

### V. Galton's Law.

The most important general conclusion which has yet been reached in regard to inheritance is formulated in Galton's Law. Mr. Galton was led to it by his studies on the inheritance of human qualities, and more particularly by a series of studies on Basset hounds. It is one of those general conclusions which have been reached statistically, and I must refer for the evidence and also for its strictest formulation to the revised edition of Mr. Pearson's "Grammar of Science."[1]

As we have seen, it is useful to speak of a heritage as dual, half derived from the father and half from the mother. But the heritable material handed on from each parent was also dual, being derived from the grandparents. And so on, backwards. We thus reach the idea that a heritage is not merely dual, but in a deeper sense multiple.

To appreciate the possible complexity of our mosaic inheritance we must recall the number of our ancestors. We have two parents, four grandparents, eight great-grandparents, about sixteen great-great-grandparents, and so on. But as we go backwards the theoretical number far exceeds the reality; a reduction in the number of ancestors is brought about by inter-marriage, as this table (from Lorenz) in reference to Kaiser Wilhelm II. clearly shows.

| *Genarations.* | I. | II. | III. | IV. | V. | VI. | VII. | VIII. | IX. | X. | XI. | XII. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Theoretical Number. | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1024 | 2048 | 4096 |
| (2) Actual number known. | 2 | 4 | 8 | 14 | 24 | 44 | 74 | 111 | 162 | 206 | 225 | 275 |
| (3) Inadequately known. | | | | | | | | 5 | 15 | 50 | 117 | 258 |
| (4) Probable total. | | | | | | | | 116 | 177 | 256 | 342 | 533 |

According to Galton's Law, "the two parents between them contribute *on the average* one-half of each inherited faculty, each of them contributing one-quarter of it. The four grandparents contribute between them one-quarter, or each of them one-sixteenth; and so on, the sum of the series, $\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\frac{1}{16}+$&c., being equal to 1, as it should be. It is a property of this infinite series that each term is equal to the sum of all those that follow: thus $\frac{1}{2}=\frac{1}{4}+\frac{1}{8}+\frac{1}{16}+$&c.; $\frac{1}{4}=\frac{1}{8}+\frac{1}{16}+$&c., and so on. The prepotencies or subpotencies of particular ancestors, in any given pedigree, are eliminated by a law that deals only with *average* contributions, and the varying prepotencies of sex in respect to different qualities are also presumably eliminated."

The aim of this lecture has been to present in brief compass a statement of the leading facts of inheritance, which should be clear in the minds of all. Nothing has been said in regard to the transmissibility of acquired characters, for this cannot be ranked at present as an established fact, and some other doubtful points have been left unmentioned. The study of inheritance leaves a fatalistic—almost paralysing—impression on many minds, especially perhaps if it be believed that the acquired results of experience and education—of "nurture," in short, cannot be entailed upon the offspring. To some extent this fatalistic impression is justified, but it is well that it should rest upon a sound basis of fact and not on exaggerations. In a sense we can never get away from our inheritance. As Heine said half bitterly, half laughingly, "A man should be very careful in the selection of his parents." On the other hand, although the human organism changes slowly in its heritable organisation, it is very modifiable individually, and "nature" can be bettered by "nurture." If there is little scientific warrant for our being other than sceptical at present as to the inheritance of acquired characters, this scepticism lends greater importance than ever, on the one hand, to a good "nature," to secure which for offspring is part of the problem of careful mating; and, on the other hand, to a good "nurture," to secure which for our children and children's children is one of the most obvious of duties, the hopefulness of the task resting upon the fact that, unlike the beasts that perish, man has a lasting external heritage, capable of endless modification for the better.

[1] Reference should, however, be made to Mr. Pearson's recent paper *Proc. Roy. Soc.*, lxvi. 1900, pp. 140–164) on the law of reversion.

## *University and Educational Intelligence.*

Mr. A. Rendle Short, of University College, Bristol, has been awarded the gold medal and exhibition in physiology, the gold medal and exhibition in materia medica, and first-class honours in anatomy, upon the results of the recent Intermediate M.B. examination of the University of London. The exhibitions in physiology and materia medica are of the value of 80*l.* and 60*l.*

A discussion on the teaching of geography will be held at Cambridge on Friday, August 24, under the auspices of the Geographical Association, and in connection with the Summer Meeting. Prof. W. M. Davis, of Harvard University, will occupy the chair, and among the subjects to be brought before the Association are class excursions, map drawing, the use of the globe, geography in the grammar school, and possibilities and limitations of geography in a day school. There are several exhibits of interest to teachers of geography in the education exhibition, arranged in connection with the Summer Meeting.

Lord Bute has offered the University of St. Andrews a sum of 20,000*l.*, to be held as a fund for endowing a chair of anatomy, upon the following conditions:—(1) That the said sum of 20,000*l.* shall be paid to the University not later than ten years hence. The exact date cannot be specified, as it will depend upon completion of certain works at Cardiff. Interest at 3 per cent. will be payable to the University from the time of the appointment of the first professor until they receive the principal sum; (2) that the first presentation to the chair shall be in favour of Mr. Musgrove, the present holder of the lectureship in anatomy in St. Andrews; (3) that the lectures shall be given exclusively in St. Andrews; (4) that the course shall meet the requirements of the two first *Anni Medici*; and (5) that before the beginning of the University session, 1901–1902, the approval of the Universities Committee of the Privy Council to the establishment of the chair under the foregoing conditions be obtained, and that the approval of Lord Bute or his representatives be obtained to any further conditions embodied in the ordinance instituting the chair.

The relations between scientific work and industrial progress have been so often described in these columns that there is little new to be said upon the subject. But though readers of Nature may be familiar with many instances of the close connection between science and industry, it will be a long time before the knowledge filters down to the general public and starts a reaction in commercial and manufacturing circles. Every man of science who takes advantage of an opportunity to impress the value of scientific observation and research upon the minds of citizens

is thus doing a service to the nation, as well as extending interest in natural knowledge. Dr. P. Bedson, professor of chemistry at the Durham College of Science, has, we are glad to see, recently shown the Economic Society of Newcastle-on-Tyne some of the lessons taught by the growth of science and industry in Germany during the present century. A reasonable and organised system of education, and schools in which students receive a thorough grounding in the principles of science, and afterwards contribute something to the advancement of knowledge, are the chief factors in Germany's industrial progress. Referring to the system of examinations which still dominates so much of our educational work, and finds its highest development in connection with university teaching, Prof. Bedson points out that it partakes of the character of the training of a stud of racers. He adds :—"Possibly the instinct of sport, so characteristic of the English people, it is which commends the system of competitive examination. Too much is made of what should be regarded as a minor duty of the University, viz. the testing and marking of its students, and too little of the higher function, the training of students under first-rate teaching, with the object that those so trained should help forward the advancement of knowledge." It is satisfactory to know that the movement in favour of rational teaching in elementary schools, and regard for research in institutions of university rank, is gradually affecting scientific education in this country.

## SCIENTIFIC SERIALS.

*Symons's Monthly Meteorological Magazine*, July.—This number contains the completion of two interesting papers, by Mr. E. D. Archibald, on Indian famine-causing droughts, and their prevision. The principal facts are summarised as follows: (1) Extensive droughts occur in the dry area of Southern India at intervals of nine to twelve years, and usually, but not regularly, about a year before the sun-spot minimum. When the conditions are sufficiently acute, famine occurs in the following year. (2) A severe drought in the peninsular of Southern India is followed by a severe drought and ensuing famine in Northern India in about five cases out of seven. (3) Summer droughts tend to occur in Northern India in years of maximum sun-spot, connected in some way with the abnormal high pressure over Western Asia which prevails at such epochs. There is thus a double periodicity of droughts and famine in North India, and a single periodicity in South India in the sun-spot cycle, though the relation between the phenomena is too spasmodic and irregular to be utilised as a trustworthy factor for prevision.

*Annalen der Physik*, No. 6.—Interruption spark in the alternating circuit with metallic electrodes, by L. Kallir. The author shows that the impossibility of producing an alternate-current arc between metallic electrodes is due to the fact that the spark is confined to one semi-period of the current. Or if it extends over several periods, it is intermittent, and only appears at every alternate semi-period.—Thermoelectric force of some metallic oxides and sulphides, by A. Abt. Pyrolusite, pyrrhotite, pyrites, and chalcopyrite were used in conjunction with various metals or with each other. A pyrites-chalcopyrite couple gave an E.M.F. 10·8 times as high as an antimony-bismuth couple under the same conditions.—Anomalous electromagnetic rotatory dispersion, by A. Schmauss. Measurements of the Faraday effect for various wave-lengths in fuchsine solutions and in didymium glass justify the general conclusion that optical anomaly in dispersion is invariably associated with a corresponding electromagnetic anomaly. In strongly absorbing media the anomaly extends for a considerable distance on both sides of the absorption band, and it increases with the concentration and with the narrowness and sharpness of the absorption band.—Point discharges, by E. Warburg. In carefully purified nitrogen, the current intensity obtained from the discharge of a fine point charged to − 3310 volts is 200 times as great as from a point charged to +5180 volts. A slight admixture of oxygen reduces the proportion to 4 : 1.—Band spectrum of aluminium, by G. A. Hemsalech. The author quotes some experiments which go to show that the band spectrum of aluminium is due, not to the oxide, but to the metal itself.—Behaviour of radium at low temperatures, by O. Behrendsen. Cooling a radium preparation down to the temperature of liquid air reduces its activity by 50 per cent. Restoration to the ordinary temperature produces a considerable but transient increase of activity.—Production of kathode rays by ultra-violet light, by P. Lenard. The discharge of electrified bodies by ultra-violet light is due to their emitting kathode rays when the ultra-violet light impinges upon them. The author exhausted a vacuum tube until it no longer allowed any discharge to pass. He then exposed the kathode to ultra-violet rays from a zinc spark gap. The discharge set in again immediately, but no discharge could be obtained by similarly illuminating the anode. The rays which produce the discharge across the absolute vacuum can be deflected by a magnet, and their velocity is about one-thirtieth of the velocity of light.

## SOCIETIES AND ACADEMIES.

### LONDON.

**Royal Society**, February 8.—"On Electric Touch and the Molecular Changes produced in Matter by Electric Waves." By Jagadis Chunder Bose, M.A., D.Sc., Professor of Physical Science, Presidency College, Calcutta. Communicated by Lord Rayleigh, F.R.S.

It is claimed that the experiments described in the paper show :—

(1) That ether waves produce molecular changes in matter.

(2) That the molecular or allotropic changes are attended with changes of electric conductivity, and this explains the action of the so-called coherers.

(3) That there are two classes of substances, positive and negative, which exhibit opposite variations of conductivity under the action of radiation.

(4) That the production of a particular allotropic modification depends on the intensity and duration of incident electric radiation.

(5) That the continuous action of radiation produces oscillatory changes in the molecular structure.

(6) That these periodic changes are evidenced by the corresponding electric reversals.

(7) That the "fatigue" is due to the presence of the "radiation product," or strained B variety.

(8) That by means of mechanical disturbance or heat, the strained product can be transformed into the normal form, and the sensitiveness may thereby be restored.

June 21.—"An Experimental Investigation into the Flow of Marble." By Frank D. Adams, M.Sc., Ph.D., Professor of Geology in McGill University, Montreal, and John T. Nicolson, D.Sc., M.Inst.C.E., Head of the Engineering Department, Municipal Technical School, Manchester. Communicated by Prof. H. L. Callendar, F.R.S.

The following is a summary of the results arrived at :—

(1) By submitting limestone or marble to differential pressures exceeding the elastic limit of the rock and under the conditions described in this paper, permanent deformation can be produced.

(2) This deformation, when carried out at ordinary temperatures, is due in part to a cataclastic structure and in part to twinning and gliding movements in the individual crystals comprising the rock.

(3) Both of these structures are seen in contorted limestones and marbles in nature.

(4) When the deformation is carried out at 300° C., or better at 400° C., the cataclastic structure is not developed, and the whole movement is due to changes in the shape of the component calcite crystals by twinning and gliding.

(5) This latter movement is identical with that produced in metals by squeezing or hammering, a movement which in metals, as a general rule, as in marble, is facilitated by increase of temperature.

(6) There is therefore a flow of marble just as there is a flow of metals, under suitable conditions of pressure.

(7) The movement is also identical with that seen in glacial ice, although in the latter case the movement may not be entirely of this character.

(8) In these experiments the presence of water was not observed to exert any influence.

(9) It is believed, from the results of other experiments now being carried out but not yet completed, that similar movements can, to a certain extent at least, be induced in granite and other harder crystalline rocks.

"On the Effects of Changes of Temperature on the Elasticities and Internal Viscosity of Metal Wires." By Andrew Gray, LL.D., F.R.S., Professor of Natural Philosophy in the University of Glasgow, and Vincent J. Blyth, M.A., and